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DEVELOPMENT OF A HEALTH SCREENING PACKAGE UNDER THE UNIVERSAL HEALTH COVERAGE: THE ROLE OF HEALTH TECHNOLOGY ASSESSMENT

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ABSTRACT

This study reports the systematic development of a population-based health screening package for all Thai people under the universal health coverage (UHC). To determine major disease areas and health problems for which health screening could mitigate health burden, a consultation process was conducted in a systematic, participatory, and evidence-based manner that involved 41 stakeholders in a half-day workshop. Twelve diseases/health problems were identified during the discussion. Subsequently, health technology assessments, including systematic review and meta-analysis of health benefits as well as economic evaluations and budget impact analyses of corresponding population-based screening interventions, were completed. The results led to advice against elements of current clinical practice, such as annual chest X-rays and particular blood tests (e.g. kidney function test), and indicated that the introduction of certain new population-based health screening programs, such as for chronic hepatitis B, would provide substantial health and economic benefits to the Thais. The final results were presented to a wide group of stakeholders, including decision-makers at the Ministry of Public Health and the public health insurance schemes, to verify and validate the findings and policy recommendations. The package has been endorsed by the Thai UHC Benefit Package Committee for implementation in fiscal year 2016. © 2016 The Authors. *Health Economics* published by John Wiley & Sons Ltd.

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1. INTRODUCTION

Health screening is defined as a sieving process to identify seemingly healthy people who may be at increased risk of or already affected by a disease or condition, in order to provide proper management and care (Raffle and Gray 2007). There are two means of providing health screening to a given target population: (1) population-based screening program, defined as a screening systematically offered by invitation to a defined, identifiable population, with close monitoring and evaluation to ensure its quality and coverage, and (2) opportunistic screening, defined as a screening test offered to someone by a health professional (National Health Committee 2003). Unlike a population-based screening programme, opportunistic screening may not be checked or monitored.

Health screening, however, is not without its limitations, including medical (e.g. false positives or negatives), psychological (e.g. stress from test results), societal (e.g. stigmatisation), and economic (e.g. cost)

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implications. Moreover, the value of health screening relies heavily on the context of disease burden, acceptance rate, and availability of infrastructure and human resources; as a result, successes of screening in one country may not be appropriate in another country. Most developed countries have introduced rigorous and essential health screening in their national programs; comparatively, health screening in developing countries has largely been overlooked, leaving room for its privatisation and high out-of-pocket payments (National Statistical Office 2009; National Statistical Office 2011).

In Thailand, a population-based screening program to detect HIV in pregnant women was introduced in 2000 during the AIDS epidemic, successfully contributing to a significant reduction in mother-to-child HIV transmission (Kanshana and Simonds 2002). After introducing the Universal Coverage Scheme (UCS) in 2002, diabetes mellitus and hypertension screening for people aged 15 years and above was implemented despite the lack of strong evidence to support screening for this target population (Diabetes Association of Thailand *et al.* 2011). Currently, the three public insurance schemes in Thailand offer different health screening packages. The Civil Servant Medical Benefit Scheme for government officers and their dependents (8% of total population) covers a wide range of laboratory tests (e.g. annual chest X-rays, liver and kidney function tests, electrocardiograms, etc.) without evidence (The Comptroller General's Department 2010). Meanwhile, the social security scheme for private sector employees (16% of population) provides no support for health screening apart from occupational-related risk screening, and the UCS, which covers the remainder of the population, offers cervical cancer screening, HIV counselling and testing, and diabetes and hypertension screening (National Health Security Office 2009). Furthermore, there has been substantial demand by many stakeholders, including health professionals and the public, for screening other diseases and health risks (Health Intervention and Technology Assessment Program 2011).

This study was designed in response to requests from stakeholders, including decision-makers and representatives from the general public, to develop an evidence-based health screening package for the population that could ensure equitable access to essential health screening under the three schemes. This paper aims to illustrate an example of how to develop a health screening package and highlights the use of Health Technology Assessment (HTA) to inform a comprehensive package of population-based health screening in Thailand. HTA in this study includes evidence synthesis to provide information on safety, efficacy, and effectiveness of interventions and economic analysis to inform about the value for money and budget impact as well as social and ethical implications of introducing health technologies.

2. METHODS

2.1. Approach

Because recent studies indicate that general health screening (i.e. screening without a clear purpose) does not provide additional health benefits (Krogsboll *et al.* 2012), this study first prioritised health problems that could benefit from population-based screening in the Thai population. Health screening interventions, if appropriate, were then identified for each priority health problem using several HTA methods. After developing the health screening package, a stakeholder consultation meeting was convened to verify and validate the results and fine-tune recommendations for health screening.

2.2. Processes

1 Prioritisation of health problems

1.1 Thirty-five health problems were selected from the top 10 problems for each age group (0–14, 15–29, 30–59, and 60+) reported in the burden of disease study in Thailand (International Health Policy Program 2009). These health problems were listed with related information on incidence,

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prevalence, mortality rate, service utilisation (number and cost of inpatient admissions), disability-adjusted life years (DALYs) lost, and availability of health screening. All information was reviewed from literature.

1.2 A half-day stakeholder consultation workshop was convened to prioritise health problems, and the participants were allowed to nominate additional health problems if deemed important. A total of 41 stakeholders were divided into three groups: group I—16 technical officers representing all departments within the Ministry of Public Health and academics with experience in conducting health priority setting or health screening research; group II—10 medical practitioners representing royal colleges and medical associations; and group III—15 representatives from non-governmental organisations and lay people identified through a list of these stakeholder groups available at the National Health Commission Office. The list of 35 health problems and related information was circulated to stakeholders 2 weeks before the meeting. The Delphi technique (Vos *et al*. 2006) was modified and applied in three rounds of prioritisation. In the first round, individual stakeholders were asked to prioritise 10 health problems on the list without ranking in order, based on their opinions. The prioritisation results were summarised by each group of stakeholders. All participants were encouraged to discuss whether they agreed with the first-round results and also to provide their justifications. As such, in the second and the third round, individual stakeholders were asked to rank order five health problems on the original list including additional nominations. Each round of rankings were not intended to shorten the original list but rather to allow stakeholders to deliberate on and share reasons for supporting their prioritisation. After each round of prioritisation, the processes of result summarisation, presentation, and discussion, similar to those of the first round, were conducted.

1.3 Based on Health Intervention and Technology Assessment Program's capacity to carry out assessments in parallel for screening interventions, the top 10 health problems ranked by each of the three groups in the third round were selected as the final list of priority health problems. Detailed analysis of similarities and differences of preference among the three stakeholder groups and associated factors are presented in a separate paper (Youngkong *et al*. 2013).

2 Assessments of population-based health screening interventions

For each priority health problem, the generic process of HTA—that is, identifying and fine-tuning research questions, reviewing literature, selecting the appropriate HTA approach (e.g. literature reviews, economic evaluation, and budget impact analysis), conducting HTA studies, and presenting preliminary results to expert panels to verify and validate research findings and policy recommendations—was applied.

2.1 We carried out a literature review to identify population-based screening interventions for each health problem. Furthermore, document reviews on international experiences of introducing population-based health screening for each priority health problem in Australia, Singapore, the UK, the USA, and the Thai clinical guidelines were performed.

2.2 We convened expert consultation meetings to determine policy-relevant questions for assessments of population-based screening interventions. The experts included medical practitioners and representatives from respective industries and the three public health insurance schemes. The policy questions refer to indicators such as safety, effectiveness, feasibility, cost-effectiveness, and budget impact.

2.3 We conducted HTA studies according to the identified research questions obtained from the previous step. To ensure comparability of results across sub-studies, all HTA studies followed the Thai national HTA guidelines (Chaikledkaew *et al*. 2014). The preliminary results were presented to the same group of experts in order to verify and validate research findings and policy recommendations. Stakeholder engagement to review the recommended population-based health screening interventions.

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Table I. The rank order of health problems as the result of the three rounds of prioritisation

		Information provided before ranking						Ranking results		
No.	Health problems	DALYs[a]	Incidence[a] (per 1000)	Prevalence[a] (per 1000)	Number of inpatient admissions[b]	AvailableScreening technique(s)	Reimbursement of inpatient[b] (million THB)	Round 1	Round 2	Round 3
1	Ischemic heart disease	406 736	0.12	1.23	104 632	BP, lipid, FPG, ECG, EST, CT	4014	3	1 + stroke	1 + stroke
2	Diabetes mellitus	569 582	3.37	52.24	99 259	Questionnaire, FPG, OGTT, UA	919	1	2	2
3	Alcohol dependence/ harmful use	757 679	16.77	40.72	27 794	Questionnaire	191	4	3	3
4	Cirrhosis	209 249	0.08	0.34	20 497	Liver ultrasound, hepatitis B and C, LFT	239	21	3 + liver cancer	4 + liver cancer
5	Anaemia	185 838	231.63	231.63	8673	Hb, Hct	44	14	16	5 + thalassemia and malnutrition
6	Cervical cancer	87 560	0.11	0.28	16 005	Pap smear, VIA, HPV	283	2	5	6
7	HIV/AIDS	413 857	0.20	8.45	38 114	ELISA	659	6	9	7
8	Asthma	149 710	1.97	54.93	73 438	—	393	14	6	8
9	Tuberculosis	138 735	0.62	1.34	45 351	Body examination, sputum, chest X-ray	866	11	14	9
10	Nephritis and nephrosis	172 754	0.44	2.15	173 170	UA, renal function test	2194	8	7 + renal calculi and urinary bladder cancer	10 + renal calculi and urinary bladder cancer
11	Breast cancer	67 731	0.48	1.15	29 657	BSE, CBE, mammogram	536	10	11	11
12	Traffic accidents	595 899	4.53	9.39	113 862	Alcohol level	5047	11	10	12
13	Cataracts	283 201	2.56	14.00	140 200	Visual acuity	2271	16	8 + glaucoma	13 + glaucoma
14	Deafness	62 098	0.62	20.52	694	ABR and OAE	32	31	20	14
15	Osteoporosis falls[e]	No information provided prior to the prioritisation process						—	12	15
16	Anxiety disorders	65 630	0.17	14.07	6323	Questionnaire	19	27	16	16
17	Depression	474 354	38.67	19.15	5366	Questionnaire	34	11	15	17
18	Colorectal cancer[d]	No information provided prior to the prioritisation process						9 (19)	13	18
19	Drug dependence/ harmful use	5975	0.25	77.75	3920	Questionnaire	53	16	25	18
20	Bronchus and lung cancer	188 627	0.17	0.24	26 080	Chest X-ray	593	16	18	20
21	Lower respiratory tract infections	130 092	6.51	0.69	435 110	—	4678	26	—	20
22	Stroke	699 159	0.91	8.56	99 389	BP, lipid	3165	5	[c]	[c]
23	Liver cancer	359 283	0.24	0.31	32 593	Liver ultrasound, hepatitis B, C, LFT	745	6	[c]	[c]
24	Osteoarthritis	247 464	2.38	24.88	14 824	—	972	19	19	—

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Table I. (Continued)

No.	Health problems	Information provided before ranking						Ranking results		
		DALYs[a]	Incidence[a] (per 1000)	Prevalence[a] (per 1000)	Number of inpatient admissions[b]	AvailableScreening technique(s)	Reimbursement of inpatient[b] (million THB)	Round 1	Round 2	Round 3
25	Prostate cancer[d]	No information provided prior to the prioritisation process						19	25	—
26	COPD	220 640	0.61	321.45	140 074	Questionnaire	1368	22	—	—
27	Dementia	148 563	0.52	2.71	2592	Questionnaire	52	22	20	—
28	Sleep apnoea[d]	No information provided prior to the prioritisation process						24	20	—
29	Homicide and violence	128 273	1.94	2.02	41 593	Questionnaire	568	25	20	—
30	Schizophrenia	142 844	0.26	6.05	29 660	—	524	27	—	—
31	Suicides	122 250	0.50	1.93	24 293	Questionnaire	133	27	—	—
32	Epilepsy	72 041	0.39	7.58	31 900	—	273	27	20	—
33	Diarrhoea	66 925	105.02	1.15	388 387	—	1526	31	—	—
34	Skin disorders	27 567	N/A	N/A	127 318	—	1522	31	—	—
35	Drowning	103 459	0.0048	1.63	1566	—	20	—	—	—

ABR, auditory brainstem response; BP, blood pressure; BSE, breast self-exam; CBE, clinical breast exam; COPD, chronic obstructive pulmonary disease; CT, computerised tomography; DALY, disability-adjusted life year; ECG, electrocardiography; ELISA, enzyme-linked immunosorbent assay; EST, exercise stress test; FPG, fasting plasma glucose; Hb, haemoglobin; Hct, hematocrit; LFT, liver function tests; OAE, otoacoustic emission; OGTT, oral glucose tolerance test; THB, Thai baht; UA, urinalysis; VIA, visual inspection with acetic acid.

[a]Burden of Diseases, International Health Policy Program (IHPP), 2004.

[b]Database of inpatient under Civil Servant Medical Benefit Scheme and Universal Coverage Scheme (only principal diagnosis), Bureau of Policy and Strategy, 2010.

[c]Combined with another health problem in round 2 and round 3.

[d]Proposed by the participants to include in the list of health problems since round 1.

[e]Proposed by the participants to include in the list of health problems since round 2.

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Table II. Priority health problems and health technology assessment approaches and main findings

Rank	Health problems	Screening interventions identified from stakeholder consultation meetings	Policy-relevant questions	HTA approaches	Main findings	Reference
1	Ischemic heart disease and stroke	- Risk factors - Global risk assessment	Given that the previous study indicated the global risk assessment for cardiovascular diseases and their related interventions represent good value for money in Thailand, which type of global risk assessment is the most appropriated for the Thai context?	- Literature review - Analysis of secondary data (comparative analysis of accuracy of global risk models) - Budget impact analysis	A locally developed and validated model namely RAMA EGAT score is recommended to be administered to all Thai population aged 35 years and above at 5-year intervals. The budget impact was calculated and it is financially feasible for the Thai setting (cheaper than previously recommended screening for metabolic syndrome in Thailand).	(Kingkaew *et al.* 2013)
		- Electrocardiogram - Pulse palpation	What is the value for money of population-based screening for atrial fibrillation which is considered as a major factor for stroke?	- Literature review on the cost-effectiveness of screening for atrial fibrillation	Pulse palpation for at least 20 s for all patients aged 65 years or older visited health staff is cost-effective and feasible.	
2	Diabetes mellitus (DM)	- Screening questionnaire - Capillary blood glucose (CBG) - Fasting plasma glucose (FPG)	What cut point should be used for screening of diabetes?	- Economic evaluation of different screening strategies for type II DM - Budget impact analysis	Population-based screening for type II DM using FPG is cost-saving in general Thai population aged 30 years and above and financially feasible at 5-year intervals.	(Srinonprasert and Kingkaew 2012)
3	Alcohol dependence/harmful use	- AUDIT - ASSIST	What is the value for money of different screening tools for alcohol dependence and in what setting is more appropriate?	- Economic evaluation of screening for alcohol abuse/misuse - Budget impact analysis	Screening for alcohol dependence (both AUDIT and ASSIST) followed by a brief intervention is a cost-effective.	(Chantarastapornchit *et al.* 2013)
4	Cirrhosis and liver cancer	- HBV screening (HBsAg and anti-HBs)	Does screening for chronic hepatitis B—main risk factor for cirrhosis and liver cancer in Thailand—for general population represent a good value for money and financially feasible?	- Economic evaluation of alternative HBV screening programs - Budget impact analysis	Once in a lifetime screening for chronic hepatitis B and treatment or vaccination with HBV vaccine, if appropriate, for general Thai population at the age of 30 years is cost-effective and financially feasible.	(Tantai *et al.* 2014)
		- HCV screening (anti-HCV and HCV RNA)	Given that screening for hepatitis C in general population is unlikely to be cost-effective because of low incidence, whether screening for hepatitis C in high-risk group, that is, HIV-infected population, is cost-effective?	- Economic evaluation of HCV screening and treatment for HIV-infected patients in Thailand	Once in a lifetime screening and treatment for chronic hepatitis C in HIV-infected patients is cost-saving	(Dumrongprat *et al.* 2013)
		- Cancer risk score - Ultrasonography	What is the availability, effectiveness, and feasibility of screening for cholangiocarcinoma?	- Literature review of domestic and international databases	No evidence available on the effectiveness of cholangiocarcinoma screening in Thailand and overseas	(Kumluang *et al.* 2013)
5	Anaemia, thalassemia, and malnutrition	- Haematocrit (Hct) - Haemoglobin (Hb) - Complete blood count (CBC)	Whether screening for anaemia in infants aged 9 months is feasible and what test—haematocrit (Hct), haemoglobin (Hb), and	- Literature review of domestic and international databases	Iron deficiency anaemia screening with CBC should be performed for all infants at 9 to 12 months of age during their first MMR vaccination. Haematocrit (Hct) can be	(Koopitakkajorn *et al.* 2013; Sommana *et al.* 2013)

(*Continues*)

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Table II. (Continued)

Rank	Health problems	Screening interventions identified from stakeholder consultation meetings	Policy-relevant questions	HTA approaches	Main findings	Reference
			complete blood count (CBC)—are more appropriate in what health care setting?		substituted where CBC cannot be performed in some health care facilities.	
		- National Record Form - Body mass index (BMI) - Physical examination	What is the most appropriate way to measure nutritional status Thais with different age groups?	- Literature review of domestic and international databases	Children aged 0–18 years should be screened and measured for their development according to the National Record Form. For people aged 15 and above, BMI should be assessed in every hospital visits. For people aged 60 and above, screening for history of food consumption, unintentional weight loss or continued weight loss, and BMI should be performed in every hospital visits.	
6	Cervical cancer	- Pap smear -Visual inspection with acetic acid (VIA)	What is the best value for money of cervical screening in general population starting from 20, 25, and 30 years old?	- Economic evaluation of alternative cervical screening programs - Budget impact analysis	Based on economic reason, 3-year interval of pap smear and/or VIA screening for all women aged 30–60 should be introduced as a replacement of the current practice, that is, 5-year interval screening for all women aged 34–60 years.	(Praditsitthikorn 2013)
7	HIV/AIDS	- Provider-initiated voluntary counselling and testing (VCT) for HIV - Community-based service (Home-based VCT or workplace-based VCT)	What is the most appropriate option for population-based HIV testing in Thailand?	- Literature review on the domestic and international databases	Based on the local study, provider-initiated VCT for all people visited health care facilities was proven to be effective and cost-effective in Thailand.	(Rattanavipapong and Teerawattananon 2013)
8	Asthma	N/A	Are there any effective or proven cost-effective options for asthmatic screening for general population?	- Literature review of domestic and international databases	No evidence on effectiveness of asthma screening in the general population	(Srisuwan *et al.* 2013c)
9	Tuberculosis	- Chest X-ray	What is the current evidence on chest X-ray for tuberculosis screening?	- Literature review of domestic and international databases	No evidence supported the use of chest X-ray for tuberculosis screening in general population. The potential harm outweighs the good. The screening (using various measures including medical history, symptomatic approach, and sputum test and chest X-ray) should be conducted only in high-risk groups or symptomatic cases.	(Srisuwan *et al.* 2013b)
10	Nephritis, nephrosis, renal calculi, and urinary bladder cancer	- Urine analysis (blood urea nitrogen and creatinine) - Urine dipstick	What is the current evidence on urine analysis for nephritis, nephrosis, and renal calculi and whether the screening is effective and cost-effective among general population?	- Literature review of domestic and international databases	Renal function tests for nephritis and nephrosis in general population provide only small benefit and are considered cost-ineffective. No evidence on effectiveness of urine analysis for renal calculi.	(Srisuwan *et al.* 2013a)

(*Continues*)

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Table II. (Continued)

Rank	Health problems	Screening interventions identified from stakeholder consultation meetings	Policy-relevant questions	HTA approaches	Main findings	Reference
11	Breast cancer	- Mammogram - Breast self-exams (BSE) - Clinical breast exam (CBE)	What is a value for money for once or twice in a lifetime screening of mammogram in population aged 40–59 years?	- Economic evaluation of once or twice in a lifetime mammographic screening in Thailand	Population-based screening for breast cancer screening with mammography for once and twice in a lifetime in women aged 40–59 years is cost-ineffective.	(Anothaisintawee *et al*. 2013)
12	Traffic accidents	Health examination (non-specified)	What is current evidence on health examination for driving license approval in general population, elderly and public drivers?	- Literature review of domestic and international databases	Existing evidence showed that visual acuity screening in drivers aged 60 and above is effective and feasible without any significant cost.	(Kumdee *et al*. 2013)

ASSIST, Alcohol, Smoking, and Substance Involvement Screening Test; AUDIT, Alcohol Use Disorders Identification Test; BMI, body mass index; CBC, complete blood count; FPG, fasting plasma glucose; Hb, haemoglobin; HBV, hepatitis B virus; Hct, hematocrit; HCV, hepatitis C virus; MMR, measles mumps and rubella vaccine; VCT, voluntary counselling and testing for HIV.

The overall findings and recommendations of a population-based health screening package were subsequently presented at a half-day meeting to a broad range of stakeholders for verification and validation. The meeting included 90 participants comprised of 35 health professionals/health care providers, 21 patient group representatives, 14 policymakers, 8 representatives from public (payers) and private insurers, 6 academics, and 6 representatives from industrial associations. The recommendations on the screening interventions summarised from this step were then considered by policymaking bodies for the universal health coverage scheme benefits.

3. RESULTS

3.1. Priority health problems that require population-based screening

A total of 12 out of 35 health problems were selected as priorities for further assessment to identify appropriate population-based health screening. Table I provides background information and ranking results of each health problem. The 12 health problems accounted for 66% of the total DALYs, 38% of total number of inpatient admissions, and 57% of the total cost of inpatient services in Thailand.

3.2. Assessment of population-based health screening interventions

Table II shows information on 16 policy-relevant questions identified for the 12 priority health problems from expert consultation meetings (refer to process 2.2), HTA approaches, and main findings. Ten questions could be assessed by reviewing previous studies on the screening intervention's safety, effectiveness, and cost-effectiveness. The other six questions required local evidence on economic evaluation. Of these, five questions needed budget impact analysis. Details of six economic evaluation studies conducted for assessing health screening interventions following the policy-relevant questions are presented in Table III.

From the main findings of HTA studies, four screening interventions were not recommended because the review identified no availability of population-based screening interventions (for cholangiocarcinoma and asthma), evidence of possible harm (chest X-ray for population-based screening of asymptomatic tuberculosis), and no evidence on effectiveness (urinary analysis and renal function tests for screening of nephritis, nephrosis, and renal calculi). Mammography for breast cancer was not recommended because of the fact that it does not represent good value for money given that the best option, which is once in a lifetime mammographic screening for women aged 40–49 and 50–59 years, yields an incremental cost-effectiveness ratio (ICER) of 1 847 000 and 1 369 000 baht/quality-adjusted life year (QALY) gained, respectively.

In total, seven population-based health screenings were recommended based on economic evaluations of which the ICERs ranged between cost saving to 136 000 baht/QALY, which is lower than the present ceiling threshold of 160 000 baht/QALY recommended by the sub-committee for the development of the universal health coverage benefit package and service delivery in Thailand (Teerawattananon *et al*. 2014). These interventions included the following:

- Screening for cardiovascular diseases using global risk score (blood pressure, cholesterol level, waist circumference, blood sugar level, and smoking status) for those aged 35 and over every 5 years
- Diabetes screening using fasting plasma glucose for those aged 30 years and over every 5 years
- Screening for alcohol, tobacco, and drug use using verbal screening by the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) for populations aged 15–60 years every year
- Screening for chronic hepatitis B using hepatitis B surface antigen and anti-HBs once in a lifetime for those ages between 31 and 40 years
- Screening for chronic hepatitis C once in a lifetime for HIV-infected patients
- Cervical cancer screening using pap smear or visual inspection by acetic acid for women 30–60 years old every 5 years

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Table III. Details of economic evaluation studies conducted for assessing some health screening interventions

Health problems	Intervention	Comparators	Setting/ perspectives	Time horizon	Discount rate
Diabetes mellitus (DM) (Srinonprasert and Kingkaew 2012)	Screening strategies for type 2 diabetes using (1) initial screening questionnaires in general population or (2) targeted screening in selected population (age group starting from 15 to 75 years old, hypertension status or obesity (BMI > 25 kg/m^2) status). For each scenario, options of screening are (1) capillary blood glucose (CBG) and subsequent tested for fasting plasma glucose (FPG) when CBG is higher than 126 mg/dl or (2) screening with FPG. Recommended strategy: screening with FPG in people age 30 and above	No systematic screening	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes
Alcohol dependence/ harmful use (Chantarastapornchit *et al*. 2013)	Screening strategies for alcohol abuse disorder using (1) ASSIST or (2) AUDIT in male- or female-varying age groups Recommended strategy: ASSIST in male age 15–59 years old	No screening	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes
Hepatitis B (under cirrhosis and liver cancer) (Tantai *et al*. 2014)	Screening strategies for hepatitis B infection using (1) HBsAg only or (2) HBsAg, confirm with anti-HBs- and vaccine-varying age groups Recommended strategy: HBsAg, confirm with anti-HBs and vaccine in 31–40 years old, with 50% vaccination coverage	No screening	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes
Chronic hepatitis C (under cirrhosis and liver cancer) (Dumrongprat *et al*. 2013)	Once-in-a-lifetime organised screening for CHC in HIV-infected patients Recommended strategy: anti-HCV and confirm with HCV RNA and treatment for CHC in HIV-infected patients	No screening	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes
Cervical cancer (Praditsitthikorn 2013; Praditsitthikorn *et al*. 2011)	Combinations of VIA and pap smear screening, age group, and screening interval Recommended strategy: VIA in 15–45 years old and pap smear in 50–60 years old every 5 years, with 80% screening coverage	Combinations of VIA in 30–45 years old and pap smear in 50–60 years old every 5 years	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes
Breast cancer (Anothaisintawee *et al*. 2013)	Once-in-a-lifetime organised screening for breast cancer in two age groups, 40–49 and 50–59 years old Recommended strategy: once-in-a-lifetime organised screening for breast cancer in 50–59 years old	Opportunistic screening for breast cancer	Thai/societal perspective	Lifetime	3% per annum for future costs and outcomes

[a]All costs were converted to price year 2012. Further information regarding the standard cost menu can be found from Riewpaiboon (2014).

- Provider-initiated counselling and testing (screening) for HIV

There were four interventions recommended for population-based screening in Thailand even though there was no local cost-effectiveness result because they are effective interventions with very low or no cost for introduction. These include (1) pulse palpation for populations aged 65 years or older for every visit to a health facility to detect atrial fibrillation; (2) complete blood count for infants aged 9–12 months who visit health

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Table III. (Continued)

Health problems	Source of cost data[a]	Incremental costs	Source of outcome data	Incremental QALYs	ICER	Budget impact
Diabetes mellitus (DM) (Srinonprasert and Kingkaew 2012)	Cost and resource use: primary data collection, literature review (local data sources), and standard cost menu	−1300	Effectiveness: literature review Utility: literature review (local data sources, using EQ-5D-3L health states from Thai patients with a valuation based on preferences from general Thai population)	0.06	Dominant	116 million per year
Alcohol dependence/ harmful use (Chantarastapornchit *et al*. 2013)	Cost and resource use: literature review (local data sources)	−300	Effectiveness: literature review	0.038 (Incremental life year gained)	Dominant	712 million per year
Hepatitis B (under cirrhosis and liver cancer) (Tantai *et al*. 2014)	Cost and resource use: based on Tantai *et al*. (2014) and standard cost menu	−1500	Effectiveness: literature review Utility: literature review (non-Thai population utility scores)	0.13	Dominant	1792 million per year (including vaccination)
Chronic hepatitis C (under cirrhosis and liver cancer) (Dumrongprat *et al*. 2013)	Cost and resource use: literature review (local data sources) and standard cost menu	−23800	Effectiveness: literature review Utility: literature review (non-Thai population utility scores)	0.28	Dominant	156 million per year
Cervical cancer (Praditsitthikorn 2013; Praditsitthikorn *et al*. 2011)	Cost and resource use: based on Praditsitthikorn *et al*. (2011)	−170	Effectiveness: based on Praditsitthikorn *et al*. (2011) Utility: based on EQ-5D-3L health state from Thai patients from Praditsitthikorn *et al.* (2011), with a valuation based on preferences from general Thai population	0.007	Dominant	Not applicable (indication for 15–29 years of age were modified to 'at first sexual encounter')
Breast cancer (Anothaisintawee *et al*. 2013)	Cost and resource use: literature review (local data sources) and standard cost menu	1835	Effectiveness: literature review Utility: derived from an economic evaluation of traztuzumab for treating breast cancer in Thailand	0.0013	1 368 764	Not applicable (not recommend as the ICER exceed Thai threshold)

facilities to receive mumps, measles, and rubella vaccination to detect iron deficiency anaemia; (3) a series of recommendations focusing on body mass index and verbal screening on food consumption in order to detect malnutrition and over-nutrition; and (4) visual acuity screening for populations aged 60 years and above who hold a lifetime driving license to prevent traffic accidents caused by the elderly.

A total of 11 population-based health interventions were recommended for the Thai population based on age, sex, and frequency of screening (Figure 1). The estimation of the budget impact for implementing this package indicated that it would cost 380–400 baht per capita (15 years and above) per year on average or 19 000–20 000 million baht per year.

3.3. Stakeholder engagement

The recommendations for the health screening benefit package were presented to a wide range of stakeholders on 4 March 2013 (refer to process 3), which were well received with only a few minor comments, for example, the need for pilot studies for a program, such as hepatitis B and C screening, which had never been

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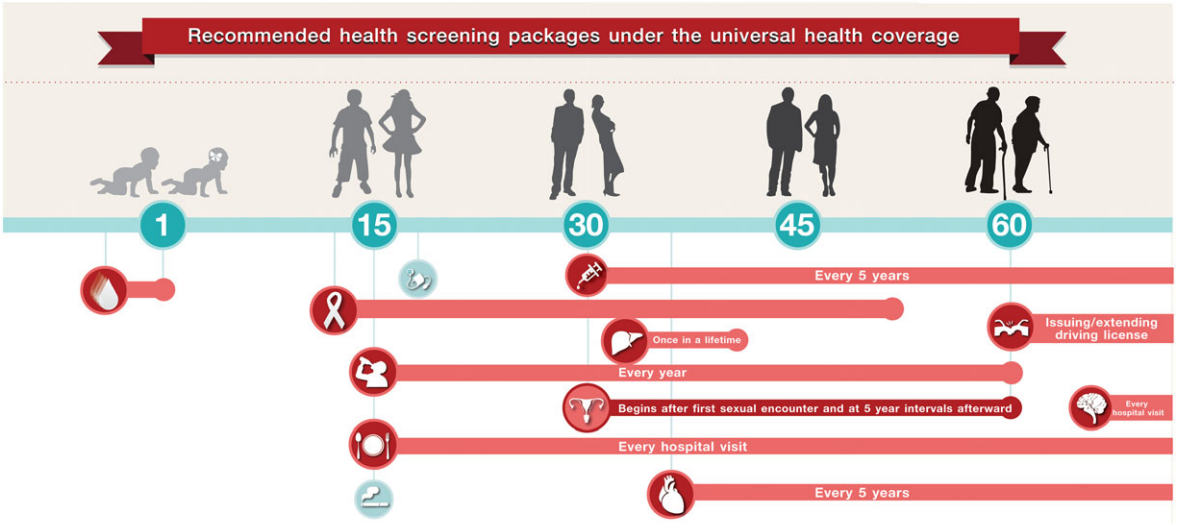

Figure 1. Recommended health screening interventions and related activities for the Thai population based on age, sex, and frequency of screening

implemented in Thailand. The meeting participants also discussed governance for implementing the recommended package, monitoring and evaluation of its impact, and revising the package in the future.

4. DISCUSSION

This study describes the use of HTA to inform the comprehensive package of population-based health screening in a middle-income country. It is evident that economic evaluation can play an important role in decision-making, although it is not necessary to include it in every assessment of health screening interventions, for example, when there is no intervention available or a lack of effectiveness evidence and the potential harm outweighs the benefits. Based on our experience, economic evaluation for health screening poses methodological challenges because most studies that assess efficacy or effectiveness of screening interventions usually only report the sensitivity and specificity of the test. There are only a few studies that address the final health outcome or impact of screening, such as population morbidity and mortality. Therefore, model-based health economic evaluation is applied as a main approach in order to estimate short- and long-term costs and consequences of screening.

It was found that a majority of the health screening interventions considered in the study are cost-effective (Figure 2), especially in comparison with no screening leading to delayed treatment. The delayed treatment is an appropriate comparator in the Thai health care setting because Thailand provides universal access to

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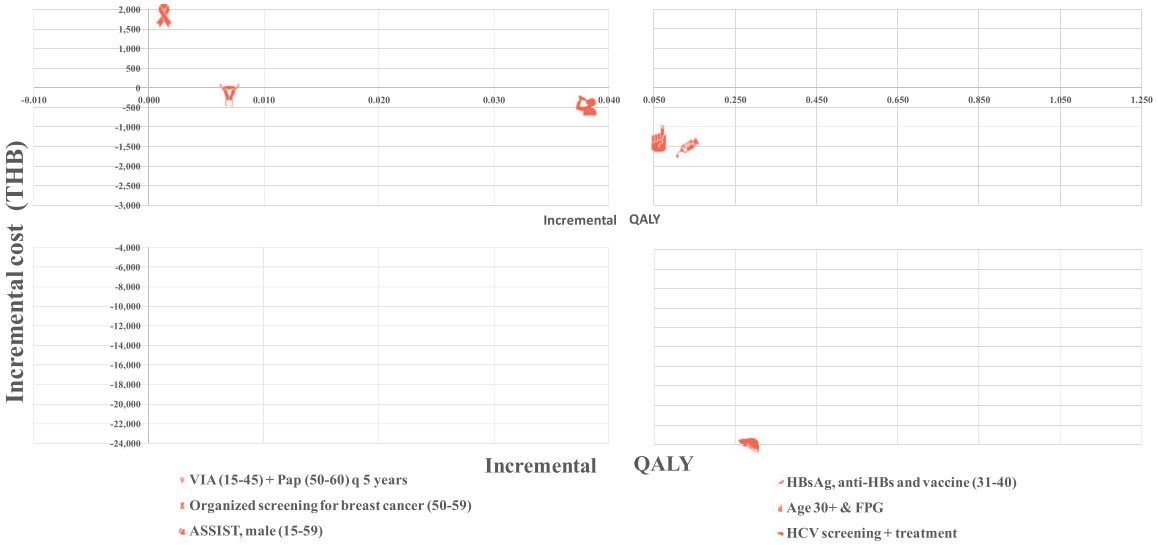

Figure 2. Incremental cost-effectiveness plane illustration of selected screening interventions

treatment of all diseases (Mohara *et al*. 2012; Teerawattananon *et al*. 2014). Another reason for good value for money is that the health problems addressed have a high disease burden and associated screening interventions are likely to have high yield, that is, all of the interventions lead to early detection and reduce future burden of caring for and treating common diseases, resulting in good value for money. In the case of breast cancer screening, the economic evaluation results showed that Thailand has a much lower disease incidence and prevalence compared with Western countries (Ferlay *et al*. 2013), which contributed to excluding population-based screening for breast cancer and instead indicated that the health care system should focus on primary prevention, such as smoking cessation, obesity control, and treatment of breast cancer. In addition, the cost-effectiveness analyses used a societal perspective and adopted a lifetime time horizon, so short- and long-term benefits of health screening were appropriately counted in the analyses.

In the literature review, a number of economic evaluations of health screening were identified, but only a few adopted cost-utility analyses. The majority of studies used cost-effectiveness approaches (reported in terms of cost per case detected) (Petrou *et al*. 2000; Pattanaphesaj and Teerawattananon 2010), resulting in a tendency for high cost per one case detected because the screening applies to a majority of the population whereas the cases detected occur only in some. On the contrary, this study considers potential savings from late treatments as a result of early detection, showing that many health screening interventions were cost-saving.

This study also illustrates how HTA can be incorporated into policy mechanisms for the development of the benefit package. Figure 3 illustrates that stakeholders can play a significant part in making the benefit package development systematic and feasible. For instance, stakeholders can prioritise topics for assessment using explicit criteria and a deliberative process, help fine-tune research questions and the scope of study, and verify and validate preliminary results as well as fine-tuning policy recommendations. Once final results have been obtained and policy recommendations on the package as a whole have been formed, a stakeholder consultation meeting can help to verify and validate the benefit package. Note that stakeholders involved in each group may or may not be the same, depending on the context of each meeting. We believe that this process is robust and can be powerful to systematically develop and legitimise policy-relevant HTA information.

Regarding the method of HTA, it is unlikely that only one approach is enough to address policy concerns. Although economic evaluation can provide significant information on whether an intervention is worthwhile, decision-makers and stakeholders also request for other information, such as disease burden,

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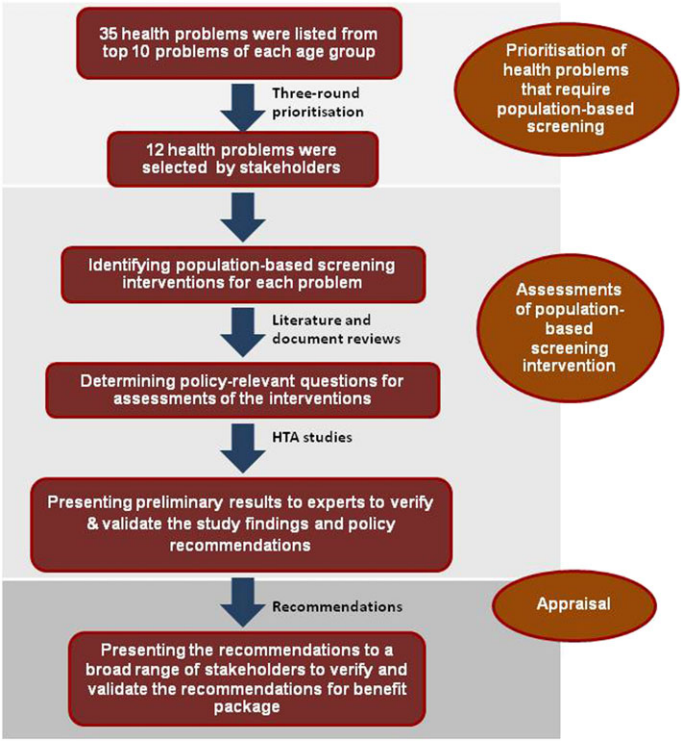

Figure 3. Health technology assessment process used in developing health screening package in Thailand

public acceptance (through prioritisation and consultation), budget impact, and affordability. Because this study focused on population-based screening under the universal health coverage in Thailand, meaning that options are considered to actively provide screening to all eligible populations using public finances, equitable access to screening in terms of financial barriers is no longer an issue. However, it may be the case that even though the service is in need and health care providers provide it freely—supply—the eligible population may not access the service because of the lack of knowledge and awareness or geographical restrictions. In this regard, health care providers need to address the issue of raising awareness and make the service more geographically accessible, for example, in communities. This issue is related to package implementation. At this stage of the design, issues that are considered are synergic options of the health interventions in the package, offering several screening interventions in the same setting and at the same frequency (Figure 1, which collates our recommendations and is used for communication with providers and the public). This is different from other HTA studies on treatment because poor and vulnerable populations are likely to have limited access.

Given that the appropriateness of health screening depends on many factors such as disease burden, health system infrastructure, level and mechanism for health financing, etc., the results of this study may not be generalisable across settings; however, the approach, that is, process and methods, may be applicable. Screening interventions that are cost-effective in Thailand may not represent good value for money in other settings. However, the HTA process is more generalisable.

In addition, the synergies across health interventions were considered in this study. For example, in the assessment for alcohol dependence/harmful use, both Alcohol Use Disorders Identification Test and ASSIST are cost-effective interventions; however, the researchers opted for ASSIST because the tool is also useful for screening of smoking. Therefore, the selection of ASSIST has a synergic effect in the implementation of cardiovascular disease screening, of which smoking is one of the major risk factors. Another example is the

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current screening of diabetes mellitus (DM) every 5 years (versus annually) in order to screen DM and global risk assessment simultaneously. This is a practical advantage and promotes incentives for people to screen for global risk of CVD as well, because there is less awareness for this issue in Thailand.

Deliberative process was on the prioritisation of disease and health problems for assessment of screening interventions. The availability of screening in the Thai health system was discussed, but other issues, for example, human resources, equipment, or facility shortages, were not discussed because the meeting focused on prioritisation and the group of stakeholders at the meeting, such as lay people and civil society, were not the appropriate group to discuss such issues. However, the shortage issues were discussed after prioritisation in a subsequent meeting comprised of health experts and industry for each disease and health problem before assessment. In these meetings, the shortages of human resources, equipment, and facilities were discussed in order to identify key screening interventions that were worthwhile for assessment under the Thai setting. As a result, interventions that were not feasible in real policy were automatically excluded from the process, for example, the exclusion of liquid-based pap smear for screening of cervical cancer because of the lack of feasibility.

Not all health screening is necessarily favourable in terms of health and economic consequences. Many health screening programs with evidence of unfavourable impact were excluded in the process. For example, screening of prostate cancer was excluded because of a consensus during the prioritisation process that there is clear evidence against population-based screening of prostate cancer. Other examples are chest X-rays among general population (no proven effectiveness) and screening for hepatitis C among general population (strong expert opinion against this approach because of low disease prevalence).

This study had some limitations. First, because of the limited capacity to carry out assessments in parallel for screening interventions, the screening package was proposed with constraints of 12 priority health problems; there are other screening interventions outside those 12 health problems that proved to be cost-effective in the Thai context and should be considered for coverage decision, such as prenatal screening for Down's syndrome (Pattanaphesaj and Teerawattananon 2010) and refractive error screening in pre-primary and primary school children (Teerawattananon *et al.* 2014). Second, no referral to treatment system, once the positive results were detected from the screening, was considered as a result of this study.

The results of this study were presented to the UCS authorities, and the proposed screening package was accepted in November 2014. The national program will start in October 2015. In addition, the policy recommendations by the UCS authorities include educating the general population about the rational use of health screening through various public communication channels.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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assistance on health intervention and technology assessment for governments of low- and middle-income countries.

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